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ABSTRACT

This module, one of 25 on vocational education training for careers in environmental health occupations, contains self-instructional materials on operating a microwave radiation detection monitor. Following guidelines for students and instructors and an introduction that explains what the student will learn are three lessons: (1) testing the operation of a low-power density-sensitive microwave radiation monitor; (2) conducting a functional test of a commercially available microwave oven; and (3) conducting a microwave oven leak test survey using a low-power density-sensitive microwave radiation detection monitor. Each lesson contains objectives, recommended methods and locations for practice, performance criteria, equipment and supplies to perform a task, detailed step-by-step instructions for learning a task, and performance exercises. Four performance tests cover preparing the microwave radiation monitor for use; checking the operating condition of a microwave oven; leak-testing a microwave oven; and collecting and recording microwave oven survey data. (CT)

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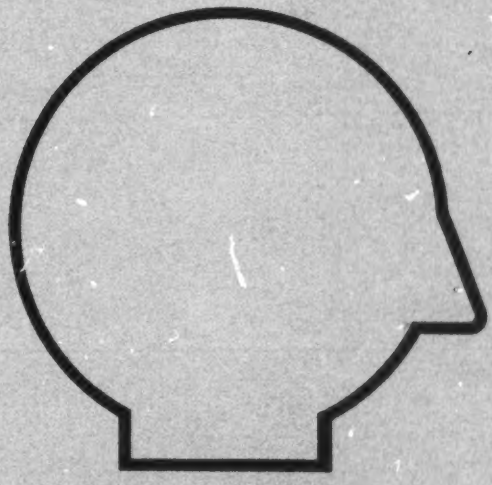
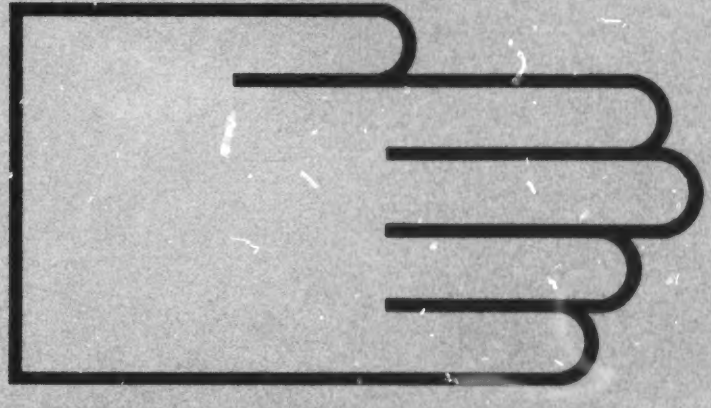


Operating a Microwave Radiation Detection Monitor



Module 10

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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FOREWORD

The Curriculum and Instruction Branch of the Office of Vocational and Adult Education, U.S. Department of Education, identified a need to improve the training opportunities for vocational education students interested in pursuing careers in environmental health. To fulfill that need, Consumer Dynamics, Inc., a Rockville, Maryland, based company, was awarded the contract to develop performance-oriented, competency-based modules in the environmental health sciences.

OPERATING A MICROWAVE RADIATION DETECTION MONITOR is one of the modules in the series, "Vocational Education Training in Environmental Health Sciences." The module content is based on selected materials in the environmental health field. The module is intended to supplement existing course materials.

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USING THESE SELF-INSTRUCTION MATERIALS

This self-instruction learning package or module is designed to allow both students and instructors flexibility of use. Although primarily intended for use in existing training programs, the module can be used by anyone interested in learning new skills or perking up old ones. Therefore, two sets of guidelines are presented--one set addressed to students and the other set addressed to instructors. First, find out how you, the student, should use the materials in this book.

GUIDELINES FOR STUDENTS

Take the Performance Test as a pretest.

When you pick up this book and work through it, your goal will not be a letter grade or a high score on an exam. Instead, you will work to develop skills that you can measure. You will not have to worry about how well someome else is doing. Before you start work on this book, you should, first, find out if you have sufficient skills to start training by reading through the section called PERFORMANCE TEST. If you think you can perform each item as specified, ask your instructor to obtain the necessary equipment and supplies so that you can demonstrate your skill level.

Work on parts you need to practice.

If you do everything well, according to the criteria in the Performance Test guidelines, you will not need to spend time working on this module. If, after taking the Performance Test you discover there are parts of the module you need to practice, follow the key to each item in FOR FURTHER STUDY.

Work straight through each lesson in the order presented.

Should you decide to completely work through this book, begin with the INTRODUCTION and go straight through each of the three lessons. The lesson begins with the OBJECTIVE of the training. Follow the instruction for each part in the order presented. Practice each step in a lesson until you can do it according to the criteria stated for the step. At the end of a lesson, do the EXERCISES. When there are audiovisuals listed at the end of a lesson, ask your instructor for help in obtaining them.

USING THESE SELF-INSTRUCTION MATERIALS

Take the Performance Test as a posttest.

Finally, after you have mastered the exercises, ask your instructor to watch you check the operation of the microwave radiation monitor and microwave oven, leak test the oven, and prepare a data summary sheet. The guidelines in the Performance Test can be used as a posttest to evaluate the quality of your performance. Turn now to the Performance Test.

GUIDELINES FOR INSTRUCTORS

Approach

The approach of these materials is to provide the student with (1) nomenclature and operating procedures of the microwave radiation monitor and microwave oven; (2) procedures for inspecting the oven; and (3) procedures for leak testing seals and the cabinet, and for compiling a data summary sheet. The lessons are sequential in that the information presented in the previous lesson serves as a basis of skill development in a later lesson. Exercises are provided to guide the student's practice of the procedures in GETTING THERE--STEPS.

Use of the Performance Test

A Performance Test is provided to serve as a guide to the skill development progress. If a student is able to demonstrate skill development by meeting the criteria for performance given in each test item, further study is not needed. Therefore, the student should be given the option of entering training at any point. To determine at what point to start, the student should take the Performance Test as a pretest. At any time during the course of study the student should also be allowed to test out of the remaining portions of training.

Also, the student's capability to accurately complete the entire task in a timely manner can be evaluated by using the Performance Test as a posttest. The items listed in the test can serve as a basis for developing other sets of procedures applicable to other types of low-power density sensitive microwave radiation detectors.

USING THESE SELF-INSTRUCTION MATERIALS

Independent Study

This module is designed to enable the student to work independently under whatever time constraints you deem reasonable. However, depending on the skill level of the students with whom you are working, you may find it desirable to start a group together at the same time with a demonstration and informal presentation on the contents of the module.

As a Laboratory Workbook

Alternatively, you may choose to use this module as a laboratory workbook in a structured laboratory session. With this option, you allow students greater access to your assistance, especially in watching them perform the pre- and posttest portions of the training.

General Instructions

Read through each lesson to anticipate what equipment and supplies you will need to make available for students to use. Also, order any audiovisuals or reading materials you think may present a complementary perspective to the training in this module.

Specific Instructions

Have your students zero the meters in a zero microwave radiation power density area. If that cannot be done, have students use the monitor case as a shield.

Check the microwave ovens to make sure the interlock systems are operating properly. This is a precaution to prevent accidental microwave radiation leakage.

Arrange to take two or three students at a time to the school cafeteria, snack bar, or nearby fast-service foodstore. Prior to the visit the students should understand each step in all three lessons in order to take advantage of working through the exercises in Lessons Two and Three.

Prior to the students performing the leak test, leak test the oven yourself. If you discover a low-level leak, record where it is and use it as a check on the student's technique. If there is a high reading, report the leak to the usual user or manufacturer's service representative.

INTRODUCTION

BACKGROUND

Microwaves are electromagnetic radiation similar to visible light. They occupy the portion of the electromagnetic spectrum that lies between radio frequency (RF) and infrared radiation (IR). Microwave radiation is a nonionizing form of radiation unlike alpha, beta, or gamma radiation, which are ionizing forms. When microwaves pass through an object, the atomic structure of the molecules in that object remains unchanged. However, microwaves do cause the molecules to spin first in one direction and then another. When they spin, the molecules give off heat, which is referred to as "molecular friction." Molecular friction is the process by which foods are cooked in a microwave oven.

Because the tissues in the human body are chemically similar to the food we eat, the body (when directly exposed) reacts to microwave radiation the same way food does when cooked in a microwave oven. For this reason the body must be protected from any exposure to microwave radiation.

The microwave oven is a source of low-level microwave radiation. Because they are fast and convenient, microwave ovens have become very popular in the last few years. With increased use of microwave ovens in the home, and in snack bars and at luncheon counters, microwave oven use is gaining attention. But unlike other kitchen appliances, the microwave oven is a source of microwave radiation--a topic that everyone hears something about regularly. As a result, people are becoming increasingly concerned about the safe use of the microwave oven.

In response to earlier concerns for user safety, the U.S. Food and Drug Administration published regulations in 1970 that set limits on the amount of microwave radiation that can escape from the microwave oven while it is operating. Manufacturers must build microwave ovens that operate within Federal limits. But the manufacturers cannot guarantee that their ovens will continue to operate within these limits. They must be properly cared for and kept clean by the users to make sure the ovens do not leak excessive amounts of microwave radiation.

You may be required to leak test microwave ovens. These tests may be part of your job duties in any one of a number of jobs in private industry or in government. The tests are performed using an electronic instrument equipped with a detector sensitive to the operating frequency of microwave ovens.

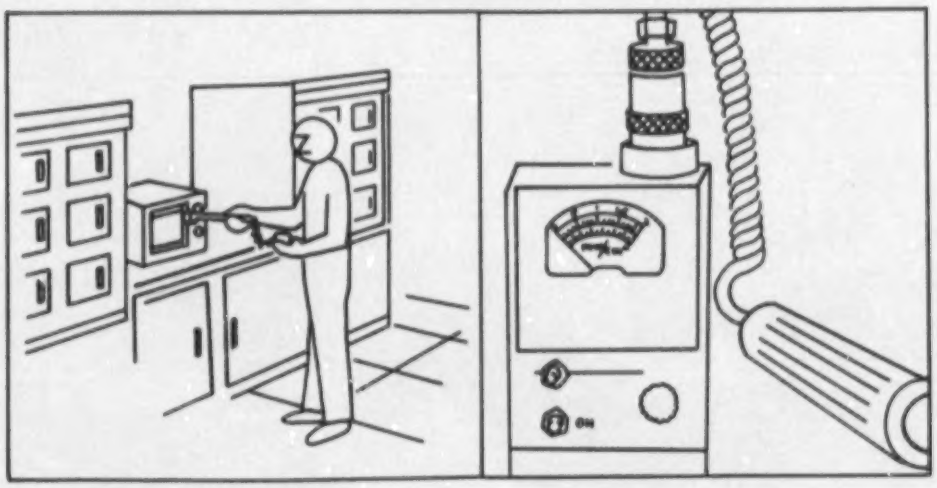
There are several types of microwave radiation monitors. The monitor used in this book is electronically simple and relatively inexpensive. When equipped with the proper detector probe, it is adequate for testing low-power density level microwave sources

BACKGROUND

such as microwave ovens. More electronically sophisticated monitors are used to measure high density levels of microwave radiation produced by industrial heaters, dryers, and medical equipment. To test such levels of safety, however, you would need to follow a more technically detailed set of procedures than those that have been included in the next few lessons.

WHAT YOU WILL LEARN

When you finish working through the steps and exercises in this book, you will be able to leak test a microwave oven using a microwave radiation meter fitted with a probe sensitive to low-power density levels of microwave radiation.



You will learn how to make low-power density measurements in three lessons:

- Lesson One

  You will be able to test the operation of a low-power density sensitive microwave radiation monitor.

- Lesson Two

  You will be able to conduct a functional test of a commercially available microwave oven.

- Lesson Three

  You will be able to conduct a microwave oven leak test survey using a low-power density sensitive microwave radiation detection monitor.

LESSON ONE

OBJECTIVE

You will be able to test the operation of a low-power density sensitive microwave radiation detection monitor.

WHERE AND HOW TO PRACTICE

You can practice this lesson in a classroom or in a work area that is not close to any source of microwave radiation. First, practice naming the parts of the monitor and how they function or are used. To test your knowledge, label the drawings in the exercises.

Each step will require you to do something with the instrument or with the operating instructions for the monitor. Read through each step before actually doing anything. If you do not understand how to do the step or what it is asking you to do, ask your instructor or supervisor for help. At the end of the lesson, follow the instructions for doing the practice exercises.

HOW WELL YOU MUST DO

You must be able to correctly label all drawings in the exercises within 5 minutes, without referring to notes or instruction materials. You must be able to perform an operational check on the meter and probe within 5 minutes without referring to notes, and be able to read the meter scale to within ± 0.05 mW/cm^2.

THINGS YOU NEED

You will need the following equipment* to work through this lesson:

- microwave radiation detection monitor, Narda Model 8200 Electromagnetic Leakage Monitor (or equivalent)
- microwave radiation detection probe, Narda Model 8221 (or equivalent); probe has a full-scale range up to 2 or 20 mW/cm^2, depending on the range selection, with a minimum sensitivity of 0.1 mW/cm^2
- 9-volt battery (Burgess 2U6 or equivalent)
- operating manual for the monitor and probe.

Instructions: Now turn to the next page and begin work on Lesson One, "Getting There--Steps."

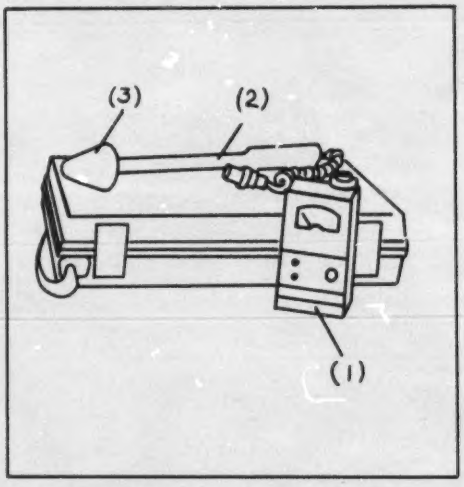
*Presentation of equipment in this module is not intended to be an endorsement of the make or model by the U.S. Department of Education.

GETTING THERE--STEPS

STEP 1

Carefully remove the microwave radiation monitor and components from the carrying case. A complete monitoring unit consists of a meter (1), a detachable probe (2), and a spacer (3) that comes as a separate unit; or a meter and probe combined into a single unit. The monitoring unit shown in this book is the meter and detachable probe. Install the 9-volt battery after removing the instrument from the carrying case.

KEY POINT 1

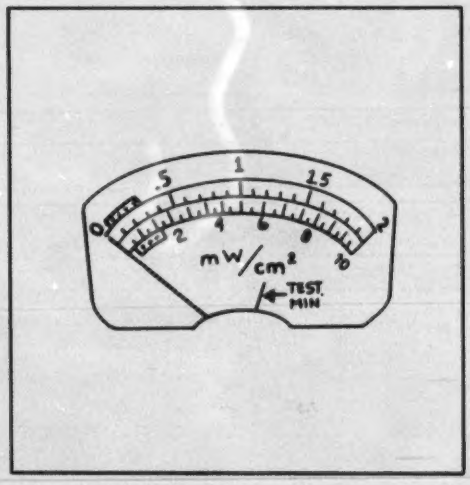


The monitoring unit may consist of a meter and detachable probe.

STEP 2

Place the monitor on the table so you can easily read the meter scales and operating switches. The monitor is a direct-reading instrument; you do not have to calculate the result after reading the scale. If you are using the monitor and probe presented in this lesson and shown in Key Point 2, note there are two scales. The upper scale is used when measuring power densities between 0 and 2 mW/cm^2--the range used for leak testing microwave ovens. The lower scale is used for measuring higher power densities of other types of microwave microwave equipment.

KEY POINT 2

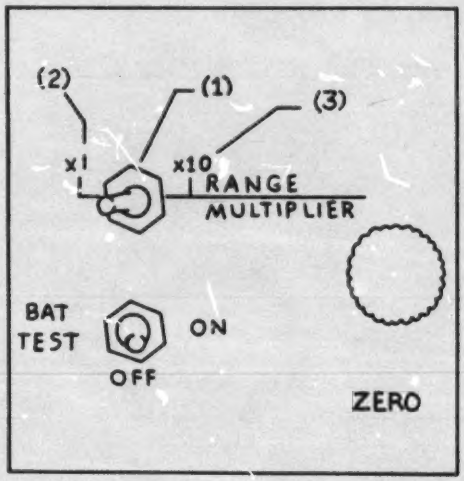


The meter scales provide a measurement in mW/cm^2 without having to convert the instrument reading.

STEP 3

Pick up the meter. Turn the range multiplier switch (1) to the X1 setting (2). Measurements between 0 and 2 mW/cm^2 can now be made using the detector probe mentioned earlier. A power density level in this range is read on the upper scale. If you turn the switch to the X10 setting (3), measurements between 0 and 20 mW/cm^2 can be made. A power density of 0-2 mW/cm^2 can also be read on the upper scale but with less accuracy.

KEY POINT 3

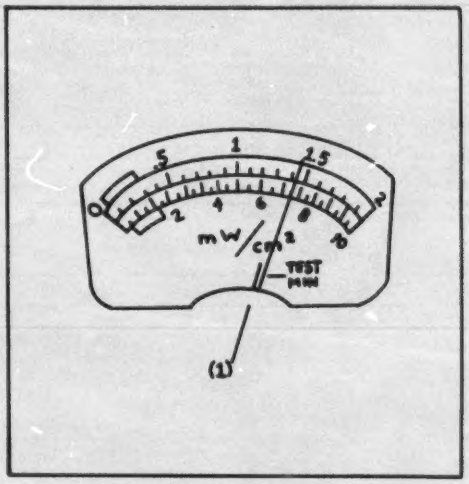


The sensitivity of the dectector can be selected with the range multiplier switch.

STEP 4

Turn the BATT TEST ON-OFF switch to the BATT TEST (Battery Test) setting. The needle should settle to the right of the TEST MIN (1) mark on the scale. If it does not, find instructions for replacing the battery in the instrument operating manual. Turn the switch to the OFF setting. Replace the battery. Repeat this step to check the new battery. Turn off the meter while you work through Steps 5 to 7.

KEY POINT 4



Replace the battery when the needle does not settle to the right of TEST MIN.

STEP 5

If you are not using a Narda probe and meter, turn to the section on the probe in your instrument operating manual. Find the detection frequency of the monitoring unit. The frequency will be a number in units of megahertz (MHz). Find the maximum power density for which the probe was designed to operate efficiently. Do not use this probe for measuring microwave radiation at a frequency other than (1) or in a power density field greater than (2).

KEY POINT 5

DETECTION FREQUENCY

(1) example: 2450 MHz

MAXIMUM OPERATING POWER DENSITY

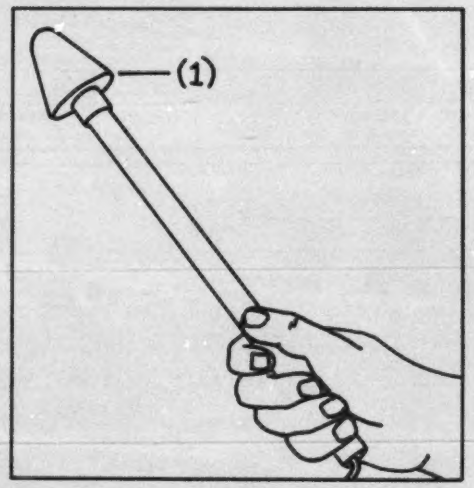
(2) example: 20 mW/cm^2

False readings and/or damage to the probe will result if you operate the probe at a different frequency or in a greater power density than that recommended.

STEP 6

Pick up the probe. Notice the 2-inch-long (5-cm) Styrofoam spacer (1) pushed onto the tip. The spacer maintains the minimum required distance between the electronically sensitive part of the probe and the microwave oven surface being leak tested. If the spacer is missing, the shape altered, or gouges made in it, obtain a replacement before doing any measuring; otherwise, the readings you get will be inaccurate.

KEY POINT 6

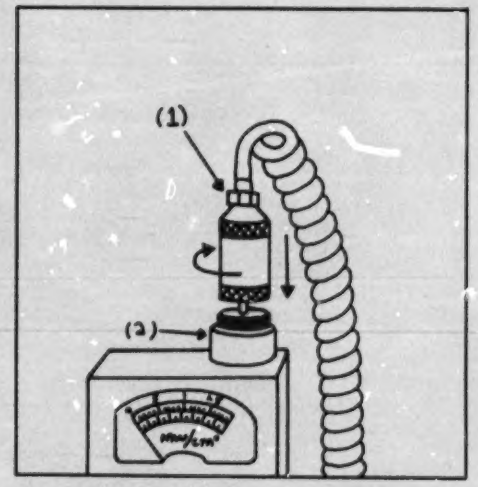


The 2-inch spacer must be attached to the probe tip to obtain accurate readings.

STEP 7

Attach the probe to the meter. Grasp the silver-colored connector at the end of the coiled probe cord (1). Push it onto the fitting on top of the meter (2). Hand tighten the collar by screwing it onto the fitting.

KEY POINT 7

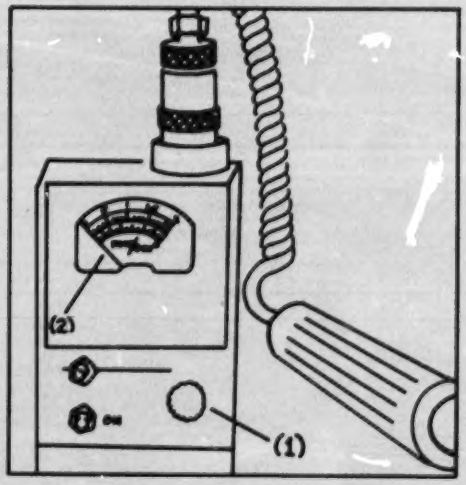


Attach the probe securely to get a good electrical connection.

STEP 8

Turn the meter on. Allow it to warm up a couple of minutes. Refer to the instrument operating manual for warmup requirements. Turn the zero adjust knob (1) until the indicator needle (2) matches the zero line on the scale. The monitoring unit is now ready to use. Turn off the unit while you work through Lesson Two.

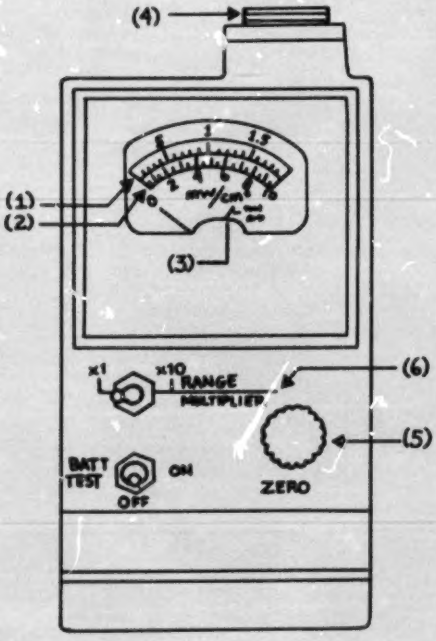
KEY POINT 8



Just before taking measurements, zero the meter.

EXERCISES

Instruction 1: Referring to the equipment and/or drawings in the lesson, label the following drawings. You must be able to name each part in the drawing and tell how it functions or is used. You should be able to do this in 5 minutes or less.



(1) _____

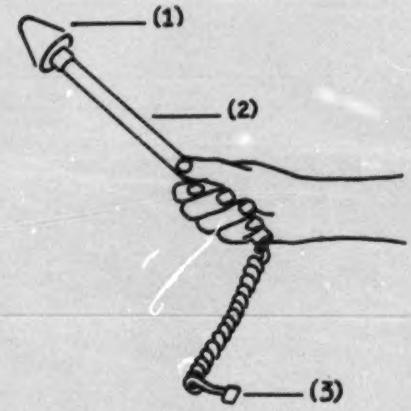
(2) _____

(3) _____

(4) _____

(5) _____

(6) _____



(1) _____

(2) _____

(3) _____

Instruction 2: Demonstrate how to get the meter and probe ready to make readings at 1.5 mW/cm^2. (Include checking the working condition of the meter and attaching the proper probe.) You should be able to do this in 5 minutes or less.

Instruction 3: When you can do the exercises in this lesson within the time stated, you are ready to begin work on Lesson Two.

LESSON TWO

OBJECTIVE

You will be able to conduct a functional test of a commercially available microwave oven.

WHERE AND HOW TO PRACTICE

You can practice this lesson where a microwave oven is being used, or in a classroom or equipment laboratory such as a physics laboratory. No other sources of microwave radiation should be detectable where you work on this lesson.

First practice naming the parts of the microwave oven and how they function. To test your knowledge, label the drawings in the practice exercises.

HOW WELL YOU MUST DO

You must be able to correctly label all drawings in the exercises in 2 minutes or less without referring to notes or instruction materials. Where a microwave oven is actually being used, you must be able to determine whether any change in the physical condition of the oven may affect its proper operation. You must be able to perform this inspection in 20 minutes or less.

THINGS YOU WILL NEED

You will need the following equipment to work through this lesson:

- o commercially available microwave oven, including the manufacturer's specifications and operating manual
- o 275-ml (9-oz) glass or plastic container (beaker or measuring cup)
- o cool water supply
- o paper and pencil
- o measuring tape or ruler.

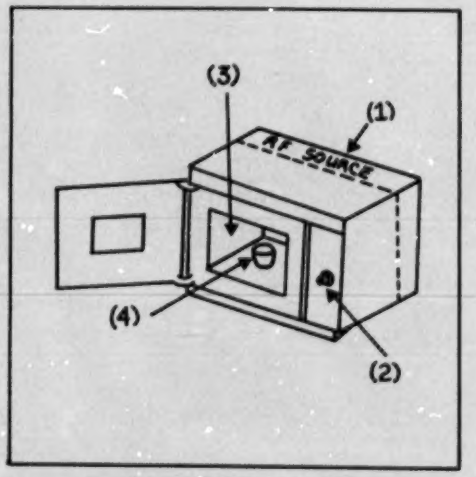
Instructions: Now turn to the next page and begin work on Lesson Two, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Before looking at the components or examining the surfaces of the microwave oven, shut off the power. The oven consists of three major groups of components: the microwave source (1), usually a magnetron tube; the control unit (2), including a timer and a variable power level selector; and the cabinet, including the door, door handle, latches, and knobs or buttons. Open the door. The inside oven surfaces make up the cavity (3) into which the load (4) is placed for cooling, heating, and drying.

KEY POINT 1

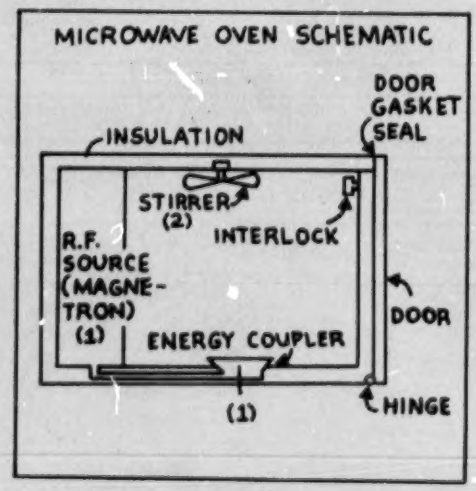


Start any inspection of a microwave oven by shutting off the power.

STEP 2

Look at Key Point 2. As shown in the drawing, the electronic components (1) for transferring the microwave energy from the magnetron tube into the cavity are located inside the oven walls. The blades of the stirrer (2) cause the microwaves to change direction. This produces even heating of the load.

KEY POINT 2



Electronic components are located between the walls of the cabinet and the cavity.

STEP 3

Look at the door and door-frame. Because uncontrolled microwave energy can be harmful, it must be contained within the cavity. Examine the gasket on the frame. It is designed to prevent microwave radiation from escaping out of the cavity when the door is closed and the oven is on. Therefore, the door edges and gasket must be kept clean and be free of damage or changes in shape.

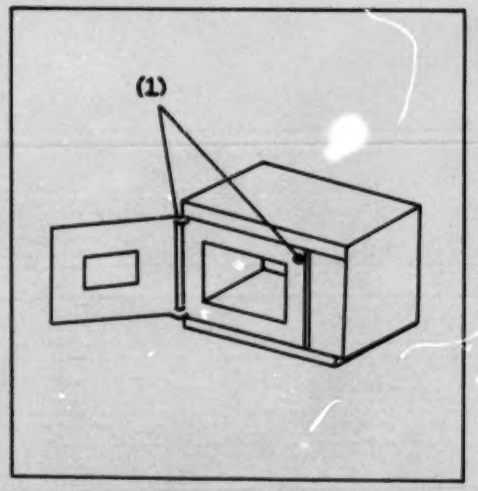
KEY POINT 3

Door seals are designed to prevent microwave radiation from leaving the cavity.

STEP 4

Look closely at the door-frame. Two safety interlocks (1) are required on all ovens, one of which must be concealed. The interlocks shut off the power automatically as soon as the door catch is released. This is a safety feature to prevent accidental exposure to microwave energy. In most newer ovens one or both interlock mechanisms are concealed in the door-frame.

KEY POINT 4

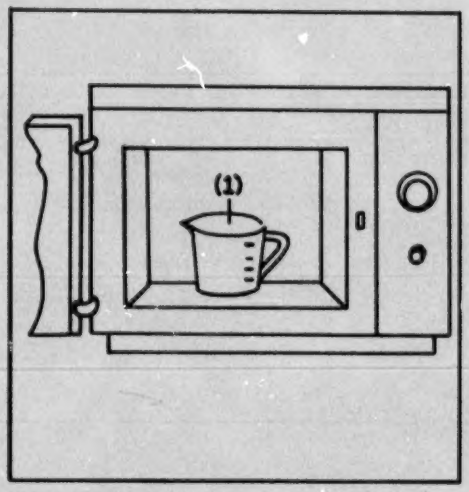


Safety interlocks are designed to automatically shut off power when the door is opened even slightly.

STEP 5

Fill a laboratory beaker or a 16-oz glass or plastic measuring cup with 275 ml (9 oz) of cool water. Place this "load" (1) in the cavity. Never turn the oven on without a load and never place metal objects or metal foil in the cavity. Failure to observe these rules will result in damage or failure of the magnetron tube.

KEY POINT 5

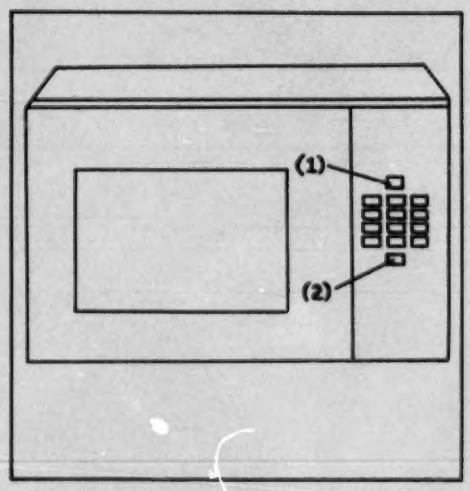


Always place a load in the cavity before turning the oven on. Do not use metallic containers for cooling, heating, or drying.

STEP 6

Turn on the timer (1) for 3-5 minutes and press the start button (2). Some of the latest oven models have separate controls for timing and setting power levels. If the oven you are using has such controls, first set the variable power level selector on the highest level possible. Then press the power-on button.

KEY POINT 6



If the oven has a separate power level selector, set it on the highest possible level before pressing the start button.

STEP 7

Check the interlock system. When the water in the beaker or cup begins to boil, vigorously open the oven door less than 1 inch. If the interlock system is working, the water will stop boiling as soon as the door catch is released. Should the water keep boiling, close the door immediately and turn off the power supply. Call your instructor's attention to the problem. When you have completed checking the interlock, turn the oven off.

KEY POINT 7

If the interlock fails when the door is opened, close the door immediately and turn off the oven.

STEP 8

Determine the condition of the oven surfaces. In the spaces provided in Key Point 8, answer these questions about the oven you are using:

(1) Are surfaces of the door seals free of grease, bits of food, and other matter?

(2) Are there cracks or separations in the door seals?

(3) Are there cracks in, or damage to, the door glass?

(4) Are there any signs that the oven may have been dropped; e.g., dents in, or scratches on, the cabinet?

KEY POINT 8

CONDITION OF THE OVEN

(1) Door seals clean?

___ yes ___ no

(2) Door seals intact?

___ yes ___ no

(3) Door glass intact?

___ yes ___ no

(4) Cabinet intact?

___ yes ___ no

Leakage will occur if the answer to any one of these questions is "no."

STEP 9

Collect information for the Microwave Oven Survey Report. First, find the manufacturer's specifications written on a small metal tag attached to the rear panel of the oven. In the spaces provided in Key Point 9, record the information given on the tag. If the tag does not provide the operating frequency, check the operating manual. If it is not given, contact the manufacturer to obtain it. You will need to provide the serial number and model number of the unit to get the operating frequency for the oven in question.

KEY POINT 9

MANUFACTURER'S SPECIFICATIONS

Manufacturer's Name: _____

Serial Number: _____

Model Number: _____

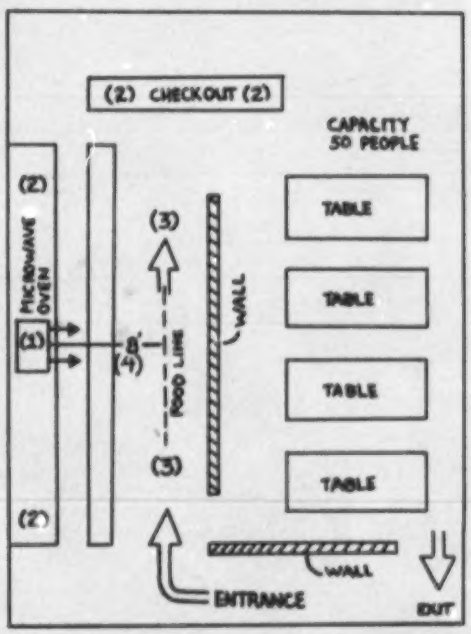
Operating Frequency: _____ MHz

Before you can use your microwave monitoring unit, you must know the operating frequency of the microwave oven.

STEP 10

Next make a sketch of the area in which the oven is located. Include in the sketch the direction the oven faces (1) when people are working near it (2) and when cafeteria patrons are walking (3) through the food line at "N" number of feet (4).

KEY POINT 10



A sketch of the oven's location may indicate who could be exposed to microwave radiation.

STEP 11

Finally, ask the oven users why, how often, and by whom the oven is used. Complete the information in the Key Point.

KEY POINT 11

USE OF THE OVEN

(1) Date oven last surveyed _____

(2) Numoer of regular users _____

(3) Number of times the oven is used each day _____

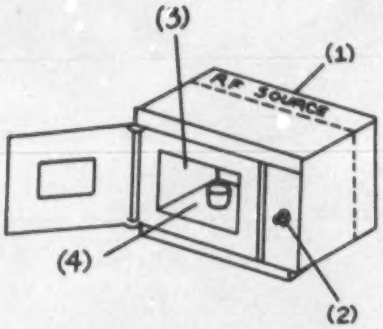
(4) Average length of time the oven is used _____

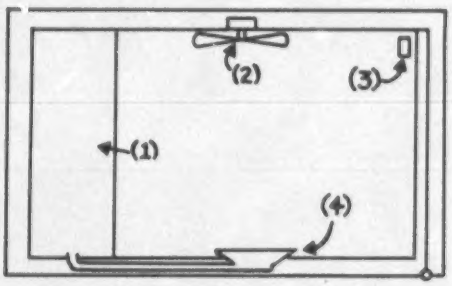
(5) Names of regularly cooled, heated, or dried items _____

Information about the use of the oven helps to determine potential exposure to microwave radiation.

EXERCISES

Instruction 1: With the microwave oven in front of you, practice naming the parts and components in Steps and Key Points 1, 2, and 6. Then label the following drawings to test your knowledge. You should be able to do this in less than 2 minutes.





(1) _____ (1) _____

(2) _____ (2) _____

(3) _____ (3) _____

(4) _____ (4) _____

Instruction 2: Visit a cafeteria or snack bar where a microwave oven is frequently used. Let your instructor make the arrangements. Do the following without referring to the list. Have a classmate check whether you have completed them all. You should be able to do this in 20 minutes or less.

1. Shut off the power to the microwave oven.
2. Fill a nonmetal container with 275 ml (9 oz) of cool water and place it in the cavity.
3. Turn on the timer and press the start button.
4. Check the interlock system.
5. Determine the cleanliness and physical condition of the oven as you did in Key Point 8.

6. Collect information for the Microwave Oven Survey Report as you did in Key Point 9.

7. Obtain information about the use of the oven as you did in Key Point 11.

8. Make a sketch of the area where the oven is located.

Instruction 3: If you are not able to visit a place where a microwave oven is in frequent use, do the items in Instruction 2 using a microwave oven that is more readily available.

Instruction 4: When you can do the exercises in this lesson within the time stated, you are ready to begin work on Lesson Three.

LESSON THREE

OBJECTIVE

You will be able to conduct a microwave oven leak test survey using a low-power density sensitive microwave radiation detection monitor.

WHERE AND HOW TO PRACTICE

You can practice this lesson in the same location and in the same way you did in the previous two lessons. When you finish working through the steps, complete the exercises.

HOW WELL YOU MUST DO

You must be able to select the probe and meter that operate in the same frequency as the oven you are surveying. You must be able to leak test the door seals, door glass, and cabinet in 10 minutes or less. You must be able to prepare and fill out a microwave survey data sheet in 20 minutes. Do not alter the door seals or override the interlock system in order to make the oven leak. Your instructor will observe your measurement technique to determine if it is adequate for detecting a radiation leak.

THINGS YOU WILL NEED

You will need all of the equipment and supplies from the previous lessons.

Instructions: Now turn to the next page and begin work on Lesson Three, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Turn on the microwave monitoring unit and check the battery. While allowing the unit to warm up, turn to Key Point 5 in Lesson One. Transfer the number you found for the probe detection frequency from that lesson to the spaces at the right on this page. Turn to Key Point 9 in Lesson Two. Transfer the number for the oven operating frequency from that lesson to the spaces at the right. If the oven operating frequency is not the same as the detection frequency of the probe, you must select a probe that is the same as the oven operating frequency.

KEY POINT 1

PROBE DETECTION FREQUENCY

_____ MHz

OVEN OPERATING FREQUENCY

_____ MHz

DO FREQUENCIES MATCH?

___ yes ___ no

If no, select another probe and/or meter.

Before you can make measurements on the oven, the operating frequency of the oven must be the same as the detection frequency of the probe.

STEP 2

Fill the beaker with 275 ml (9 oz) of cool water. If the water begins to boil while you are checking for radiation leaks (leak testing), fill it again with cool water. Close the oven door completely after placing this load into the cavity.

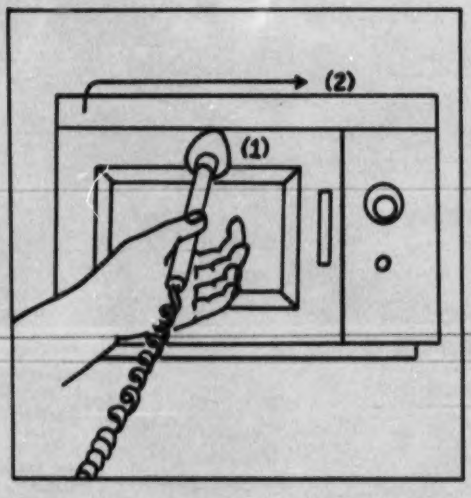
KEY POINT 2

Cool water must be used during leak testing.

STEP 3

Turn on the oven as you did in Step 6 of Lesson Two.* Turn the range multiplier switch of the meter to the X10 position. Pick up the meter in one hand and the probe in the other. Leak test the door seals with the door completely closed. Hold the probe so the tip gently touches a door edge (1). Slowly move the probe across the entire length of the edge (2) until you reach a point where you get a reading. At this point turn the shaft of the probe to obtain the highest possible reading.

KEY POINT 3



Move the probe tip slowly across the edge. When you get a reading, stop and rotate the probe to obtain the highest reading.

*Review this step before going on if you do not remember how it is done.

STEP 4

Move the probe along the remaining door edges. Under each of the four headings in Key Point 4, record the the highest reading for each point you stop at. If you cannot get any readings, turn the range multiplier switch to X1. Repeat Step 3 and record your results under Key Point 4.

KEY POINT 4

DOOR EDGE MEASUREMENTS

(1) TOP EDGE	(2) RIGHT EDGE	(3) BOTTOM EDGE	(4) LEFT EDGE
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____

HIGHEST READING: _____

If you do not get readings on the X10 setting, turn the range multiplier switch to the X1 setting.

STEP 5

Hold the probe tip gently against a top edge of the door glass. Move the probe slowly back and forth across the window until you reach the bottom of the door. When you get a reading, stop moving the probe and rotate its shaft to obtain the highest possible reading. Record your highest readings under Key Point 5. Check the power cord and all cracks and openings in the cabinet in the same way. Again record your highest readings under Key Point 5.

KEY POINT 5

DOOR GLASS LEAK TEST MEASUREMENTS

_____ _____

_____ _____

POWER CORD AND CABINET LEAK TEST MEASUREMENTS

_____ _____

_____ _____

Record the highest readings you get when checking the door glass, power cord, and cabinet for radiation leaks.

STEP 6

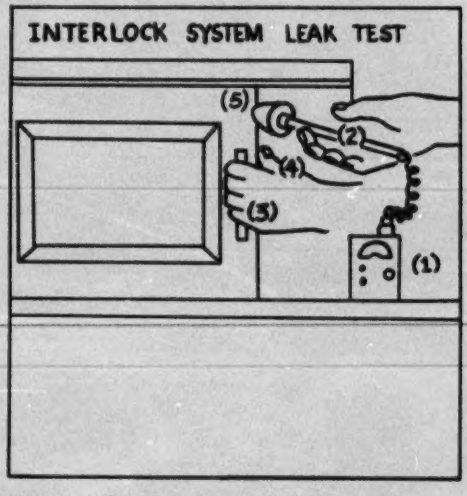
Leak test the door interlock system. Turn the range multiplier switch on the meter to the X10 setting. Turn the meter on if it is not already on, and set it on the table next to the oven (1). Make sure you can easily see the meter scale. Place the probe in your right hand (2). Grasp the oven door handle with your left hand (3). Press your left thumb against the timer panel (4) for leverage. Place the probe tip at the point (5) where the door will open. Watch the meter scale. Barely crack open the door. Note the power density level reached before the oven shuts off. The reading should be less than 10 mW/cm^2. Obtain readings at two other points. Record all three readings here:

(1) _____

(2) _____

(3) _____

KEY POINT 6



Watch the meter as you open the door. If the power density reaches 10 mW/cm^2, quickly shut the door and turn the oven off. The interlock system is not working.

EXERCISES

Instruction 1: After you inspect the microwave oven, do the following without referring to the list. You should be able to complete the list in 10 minutes or less.

1. Match the probe detecting frequency with the microwave oven operating frequency.
2. Load the cavity with 275 ml of cool water.
3. Turn on the oven.
4. Leak test the door seals and record your readings here:

DOOR EDGE MEASUREMENTS

(1) TOP EDGE	(2) RIGHT EDGE	(3) BOTTOM EDGE	(4) LEFT EDGE
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____

HIGHEST READING: _____

5. Leak test the door glass and record your readings here:

DOOR GLASS LEAK TEST
MEASUREMENTS

_____ _____

_____ _____

POWER CORD AND CABINET
LEAK TEST MEASUREMENTS

_____ _____

_____ _____

6. Leak test the door interlock system and record your readings here:

(1) _____ (3) _____

(2) _____

Instruction 2: Summarize the information and measurements you obtained in the exercises in Lessons Two and Three. You should be able to do this in 20 minutes or less. Organize the information as follows:

I. Oven Location, Users, and Frequency of Operation
II. Equipment Specifications
III. Survey Information (include information on the probe and meter used, what your measurements were, when the last survey was conducted, and your name and date you conducted the current survey).

Instruction 3: When you can do the exercises in this lesson within the time stated, you are ready to take the Performance Test as a posttest.

PERFORMANCE TEST

Instruction 1: Check your skill level or progress by working through each of the following items. If you can perform the item as well as required, place a check in the space provided. When all of the items are checked, you are ready to demonstrate your skills to your instructor. You will be considered trained in these skills after your instructor approves your performance of each item.

(Instructors: You may use this checklist in guiding your evaluation.)

PREPARING THE MICROWAVE RADIATION MONITOR FOR USE

You must be able to accurately perform the following within 5 minutes:

No. 1 _____ Install a battery in the monitor.

No. 2 _____ Test the battery of the monitor, and replace it if necessary.

No. 3 _____ Identify and record the detection frequency of the monitoring unit and the maximum power density of the probe.

No. 4 _____ Check the probe spacer and replace if damaged.

No. 5 _____ Attach the probe to the meter to get a good electrical connection.

No. 6 _____ Turn on the meter and allow it to warm up for the appropriate length of time.

No. 7 _____ Adjust the indicator needle so that it reads zero.

FOR FURTHER STUDY

If you could not perform one or more of the seven items above, review and practice the following lesson steps:

No. 1
Lesson One, Step 4

No. 2
Lesson One, Step 4

No. 3
Lesson One, Step 5

PERFORMANCE TEST

FOR FURTHER STUDY (CONTINUED)

No. 4
Lesson One, Step 6

No. 5
Lesson One, Step 7

No. 6
Lesson One, Step 8

No. 7
Lesson One, Step 8

CHECKING THE OPERATING CONDITION OF A MICROWAVE OVEN

You must be able to perform the following within 20 minutes:

No. 1 _____ Turn off the oven's power.

No. 2 _____ Examine the door, door edges, and gasket to see that they are clean, not damaged, and have not changed shape.

No. 3 _____ Load the oven with 275 ml of cool water in an appropriate container.

No. 4 _____ Turn on the timer, press the start button, and set the power level selector at the highest setting.

No. 5 _____ Turn on the power and check the interlock system.

No. 6 _____ If the interlock system fails, close the door immediately.

No. 7 _____ Turn off the power.

No. 8 _____ Identify the operating frequency of the oven.

No. 9 _____ Check the physical condition of the cabinet surface (door seals, glass, cabinet).

PERFORMANCE TEST

FOR FURTHER STUDY

If you could not perform one or more of the nine items above, review and practice the following lesson steps:

No. 1
Lesson Two, Step 1

No. 2
Lesson Two, Step 3

No. 3
Lesson Two, Step 5

No. 4
Lesson Two, Step 6

No. 5
Lesson Two, Steps 6 and 7

No. 6
Lesson Two, Step 7

No. 7
Lesson Two, Steps 1 and 7

No. 8
Lesson Two, Step 8

No. 9
Lesson Two, Step 9

LEAK TESTING A MICROWAVE OVEN

Instruction 2: As you do each testing item, tell the instructor what you do. Your instructor will carefully observe your leak testing technique, since there is no safe and readily available microwave source. You must be able to do these in 10 minutes or less.

No. 1 _____ Turn on the monitoring unit, check the battery, and allow unit to warm up.

No. 2 _____ Make sure that the probe detection frequency and the oven operating frequency are the same.

LEAK TESTING A MICROWAVE OVEN (CONTINUED)

No. 3 _____ Load oven cavity with 275 ml of cool water.

No. 4 _____ Turn on the oven and set the range multiplier switch on the meter to the X10 position.

No. 5 _____ Leak test the door seals to obtain the highest possible readings.

No. 6 _____ Leak test the door edges to obtain the highest possible reading.

No. 7 _____ Leak test the door glass, power cord, and oven cabinet for the highest possible readings.

No. 8 _____ Leak test the door interlock system.

FOR FURTHER STUDY

If you could not perform one or more of the eight items above, review and practice the following lesson steps:

No. 1
Lesson One, Steps 1 and 6; Lesson Three, Step 1

No. 2
Lesson One, Step 5; Lesson Two, Step 8; Lesson Three, Step 1

No. 3
Lesson Two, Step 5; Lesson Three, Step 2

No. 4
Lesson One, Step 1; Lesson Two, Step 6; Lesson Three, Step 3

No. 5
Lesson Three, Step 3

No. 6
Lesson Three, Step 4

No. 7
Lesson Three, Step 5

No. 8
Lesson Three, Step 6

PERFORMANCE TEST

COLLECTING AND RECORDING MICROWAVE OVEN SURVEY DATA

You must be able to do the following in 20 minutes or less:

No. 1 _____ Prepare a data sheet. Record the manufacturer's specifications.

No. 2 _____ On the same data sheet used in No. 1 above, record the condition of the oven, including cleanliness and condition of seals and other parts.

No. 3 _____ Make a sketch of the area in which the oven is located.

No. 4 _____ Interview an oven user as to why, how often, and by whom the oven is used. Record results on your data sheet.

No. 5 _____ Record on your data sheet the operating frequency of the oven and the detection frequency of the probe.

No. 6 _____ Record on your data sheet the radiation measurements of the door edges, glass, power cord, cabinet, and interlock system.

FOR FURTHER STUDY

If you could not perform one or more of the six items above, review and practice the following lesson steps:

No. 1
Lesson Two, Step 8; Lesson Three, Exercises

No. 2
Lesson Two, Step 9

No. 3
Lesson Two, Step 10

No. 4
Lesson Two, Step 11

No. 5
Lesson Three, Step 1

No. 6
Lesson Three, Steps 5 and 6

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